ENGINEERING REPORT ON EAST MARGINAL WAY PUMP STATION MODIFICATIONS

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Municipality of Metropolitan Seattle

410 W. Harrison Street

Seattle, Washington 98119

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ENGINEERING REPORT ON

EAST MARGINAL WAY PUMP STATION MODIFICATIONS

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A. INTRODUCTION

1. System History and Background

The East Marginal Way Pumping Station serves 9,610 acres within the Elliott Bay and Southwest Lake Washington sewerage areas of the Municipality of Metropolitan Seattle's comprehensive sewerage plan. These areas are listed in Table 1 and are also shown on Figure 1.

Prior to the formation of the Municipality in 1958, sewer service was available only to the areas in Table 1 listed under paragraphs 1 and 3. These areas received service from the Southern portion of the City of Seattle's Henderson-East Marginal sewerage and drainage system described and shown in Table 6-21 and Figure 6-31 on pages 132 and 141 respectively of the Metropolitan Seattle Sewerage and Drainage Survey of 1958 by Brown and Caldwell.

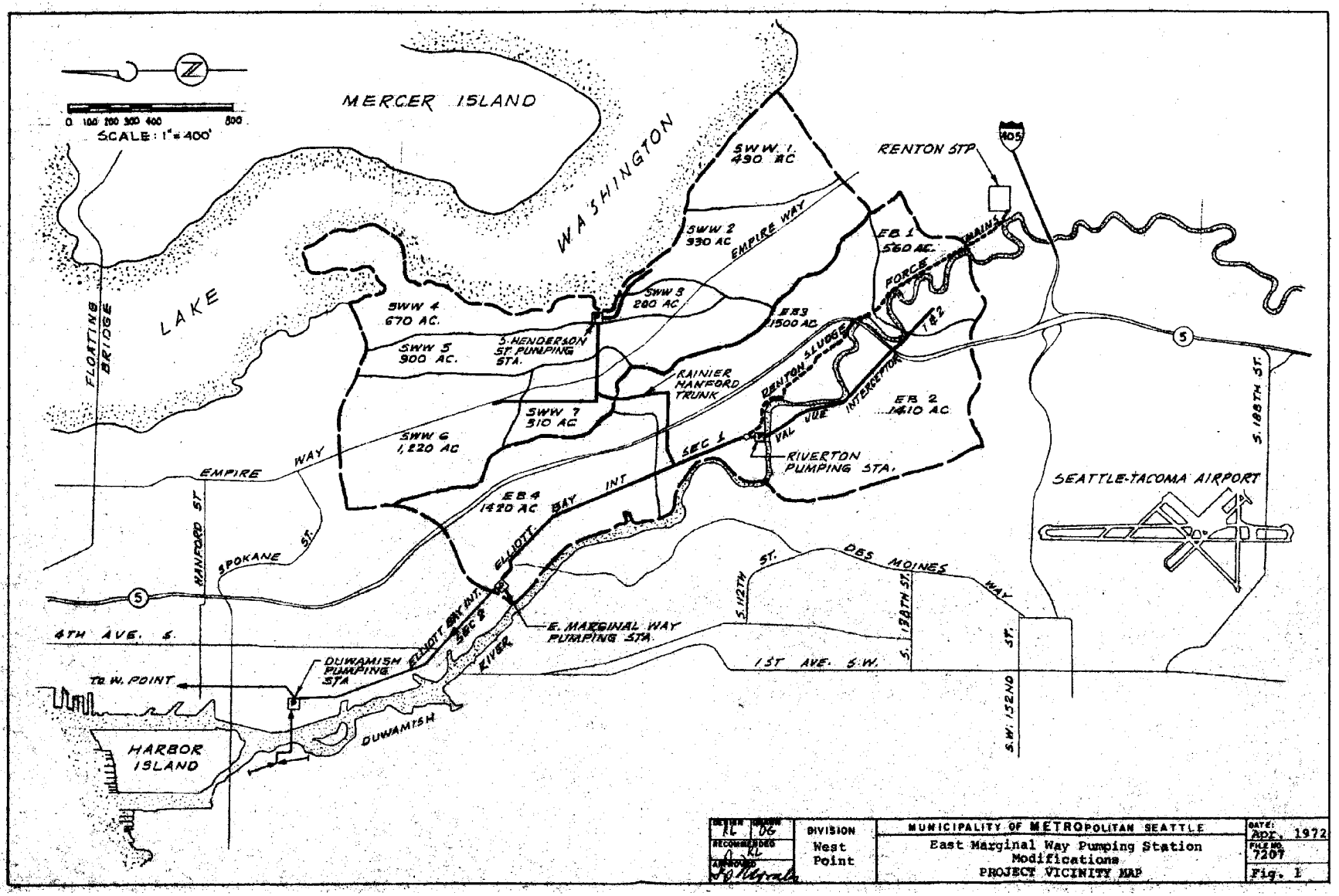
The Seattle system described has since been incorporated into the Municipality's comprehensive sewerage plan within the Elliott Bay sewerage area and the existing Seattle facilities have been revised and enlarged to conform with the comprehensive plan.

One of the major revisions implemented was the construction in 1963-64 of the Municipality's East Marginal Way Pumping Station at 7319 East Marginal Way South to replace an existing undersized City of Seattle station (P.S. 10 Figure 6-31). The new station was put into service on January 6, 1964, with an initial increment of twenty-five percent of its ultimate pumping capacity of 42 mgd, provision having been made for enlargement of the pumping units as the need arose in the future.

At this time the operating data available indicate that the present limit of the station's capacity has been reached and that the time is appropriate for expansion of the station to its ultimate design capacity.

TABLE 1: AREAS TRIBUTARY TO EAST MARGINAL WAY PUMPING STATION

Area Designation	Area in Acres
1. Served by Henderson-E. Marginal Trunk (tributary to Elliott Bay Interceptor)	
SWW-1	490
SWW-2	930
SWW-3	200
SWW-4	670
SWW-5	900
SWW-6	1,220
SWW-7	310
	4,720
2. Served by Val-Vue Interceptor 1 & 2 (tributary to Riverton P.S.)	
EB-1	560
EB-2	1,410
	1,970
3. Served by Elliott Bay Interceptor Section 1 (tributary to E. Marginal P.S.)	
EB-3	1,500
EB-4	1,420
	2,920
TOTAL AREA TRIBUTARY	9,610 acres



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2. Report Purpose and Scope

The purpose of the following report will be to:

a. Analyze the operating data and confirm the need to expand the East Marginal Way Pumping Station to its ultimate design capacity at this time.

b. Investigate the operating history of the present pumping units and incorporate the historical experience into the design criteria for the station expansion.

c. Consider technical, economic and environmental aspects to be met and recommend an expansion program most closely meeting the desired requirements.

d. Prepare the preliminary engineering design for the recommended work.

e. Prepare a construction cost estimate for the recommended work.

f. Prepare a project schedule for the recommended work.

The scope of the work will be such that contract plans and documents, scheduling and budgeting can be accomplished from the report. The report will also be in sufficient detail to obtain approval for the project from such agencies as will be required and to permit its use as a supporting document to a grant application for construction of the work.

B. EXISTING FACILITIES ANALYSIS

1. Engineering and Design Criteria

Design of all facilities in the proposed expansion will be in accordance with the criteria used for the original station design except where improvements or modifications resulting from now available operating experience dictate otherwise. These criteria are described on Pages 33-34 and 182-183 in the Municipality's Pre-Design Report on First Stage Construction of its Comprehensive Sewerage Plan, dated July 1960.

In addition, all standards of applicable agencies having jurisdiction and normal and proper engineering practice will be followed.

2. Environmental Considerations

Incorporation of the existing City of Seattle facilities and construction of the Elliott Bay Interceptor and East Marginal Way Pumping Station were accomplished as a part of the Municipality's first stage construction project to eliminate pollution and contamination of the environmental waters of the Metropolitan Seattle area. The accomplishments of the first stage construction program include the interception in August 1970 of the last raw sewage discharge to the Duwamish River and Elliott Bay, through the completion of the Elliott Bay Interceptor of which the East Marginal Pumping Station is an integral part.

In September 1970, the Metropolitan Council approved a second stage program designed to provide the facilities to maintain and upgrade water quality and to keep up with the population growth in the area. This program continues the objectives of the Municipality's comprehensive plan to protect its environmental waters and is described in detail in the Municipality's Pre-Design Report on Second Stage Construction of its Comprehensive Sewerage Plan, dated August 1970. The expansion of the East Marginal Way Pumping Station is included and described in the Second Stage Report on Page 97.

3. Existing Facilities and Extent of Service

Those portions of the Elliott Bay Interceptor and other facilities affecting the East Marginal Way Pumping Station have been shown previously on Figure 1. A detailed description corresponding to the major facilities affected on Figure 1 is given in Table 2.

The service area tributary to the East Marginal Way Pumping Station covers 9,610 acres and has previously been shown in Table 1 and Figure 1. Within this area the present population is estimated to be 42,687 persons, and the calculation for this estimate is given in Table 3.

The Municipality's comprehensive plan fully provides for the present and ultimate needs of the service area and population tributary to the East Marginal Pumping Station and has considered all aspects of regional planning for orderly development of sewerage facilities. Such expansion work as will be investigated and proposed in this report will therefore be work to improve an existing regional facility and will have the effect of strengthening the overall regional system.

TABLE 2: FACILITIES ADJOINING EAST MARGINAL WAY PUMPING STATION

Facility Description	Capacity, mgd.	Date Constructed
1. Upstream from E. Marginal Pump Station		
Renton Sludge Force Mains		
17,822 l.f. of twin 12-inch	5	12/19/63
Elliott Bay Interceptor Section 1		
(B9) 4,349 l.f. of 42-inch @ 0.10%	21	3/5/64
(B10) 10,300 l.f. of twin 42-inch @0.10%	42	paralleling existing 42-inch
110 l.f. of 60-inch @ 0.58%	140	
2. E. Marginal Way Pump Station (initial stage)	10	
Pump No. 1 - Worthington mixed flow, Model 24MCZ1		
350 RPM, 6,960 gpm (10 mgd) @ 16.4' TDH		
50 HP, Serial No. 1597736		
Motor No. 1 - Continental, Type VV682P, 350 RPM		
440 V, 3 ph, 60 cy, 105 amps, cont. 60° rise		
50 HP, Serial No. D96891		1/16/64
Pump No. 2 - Same as No. 1, Serial No.1597735		
Motor No. 2 - Same as No. 1, Serial No.D96892		
3. Downstream from E. Marginal Pump Station		
Elliott Bay Interceptor Section 2		
(B11) 4,300 l.f. of twin 42-inch @ 0.11-0.12%	42	6/18/70 paralleling existing 42-inch
Elliott Bay Interceptor Section 3		
(B12) 7,000 l.f. of 60-inch @ 0.05-0.055%	40	original City of Seattle facility

TABLE 3: TRIBUTARY POPULATION CALCULATIONS

Census Tract	1970 Count	Percent of C.T. Covered	Tributary Population
102	5,261	75	3,946
103	5,447	60	3,268
104	7,295	20	1,459
109	2,153	45	969
110	5,120	90	4,608
111	7,006	100	7,006
117	3,972	100	3,972
118	6,115	100	6,115
119	7,277	100	7,277
261	5,350	15	803
263	2,083	100	2,083
272	2,362	50	1,181
TOTALS	59,441		42,687

Source: King County Department of Planning, 1970 Census Data, Selected First Count Data Items, November 1971.

4. Performance of Existing Facilities

Since its installation in 1964, the East Marginal Way Pumping Station has been performing satisfactorily and there have not been any reports of unusual or difficult maintenance problems. A summary of the maintenance records of the two pumps in the station is given in Table 4.

In October 1971 the Municipality's computer augmented treatment and disposal system (CATAD) was put into operation and interfaced with sixteen existing pumping stations and treatment plants within the Municipality of Metropolitan Seattle. At the East Marginal Way Pumping Station the CATAD system, in addition to other functions, monitors various operating conditions, from which the performance of the station can be examined. Figure 2 in a typical computer plot of monitored electrical characteristics which have been converted to indicate frequency of pump operation and wet well water surface elevation and corresponding quantity of discharge.

An examination of Figure 2 shows the following conditions occurring in the pump station:

a. Cycling of lead pump, operating by itself, of up to 14 starts per hour and of follow pump, when operating in conjunction with lead pump, of up to 10 starts per hour.

b. The second or follow pump is being called upon to supplement the pumping capacity of the station with increasing frequency.

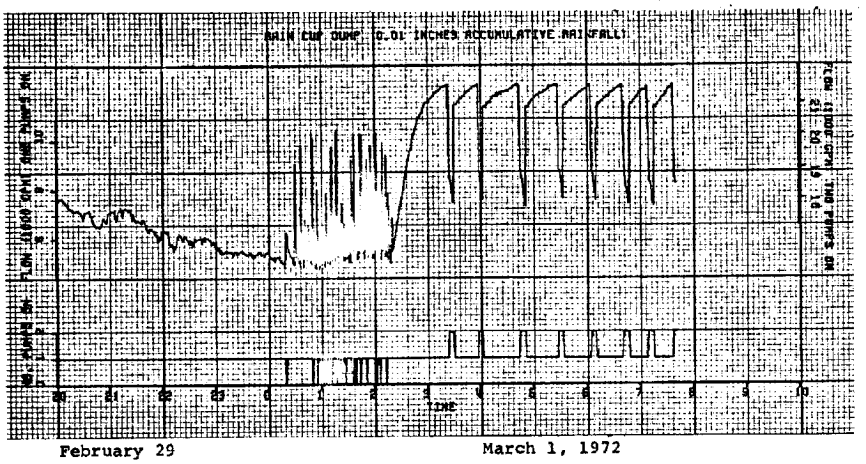
Observation (a) indicates that the tributary sewage flow into the station has increased beyond the optimum operating capacity of the wet well. This is seen from the rapid manner in which the wet well refills immediately after a pumping cycle and the resulting excessive cycling of the pump.

The same phenomenon occurs to the follow pump when two pumps are operating. The lead pump in this case is able to match a certain incoming flow but the wet well has insufficient capacity to handle the excess with the result that the follow pump is subjected to excessive cycling.

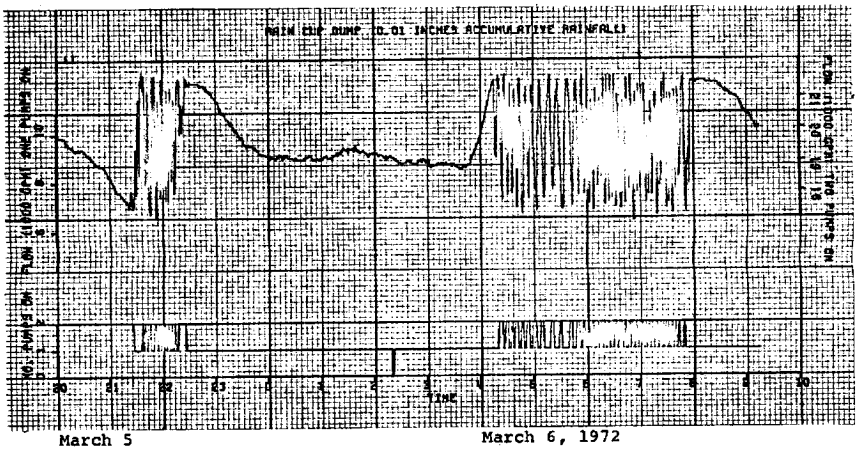
Observation (b) indicates the inability of the lead pump to meet the now existing flows and the increasing utilization of the second pump in a supplementary function thereby eliminating the station's standby capacity.

TABLE 4: SUMMARY OF STATION MAINTENANCE RECORDS

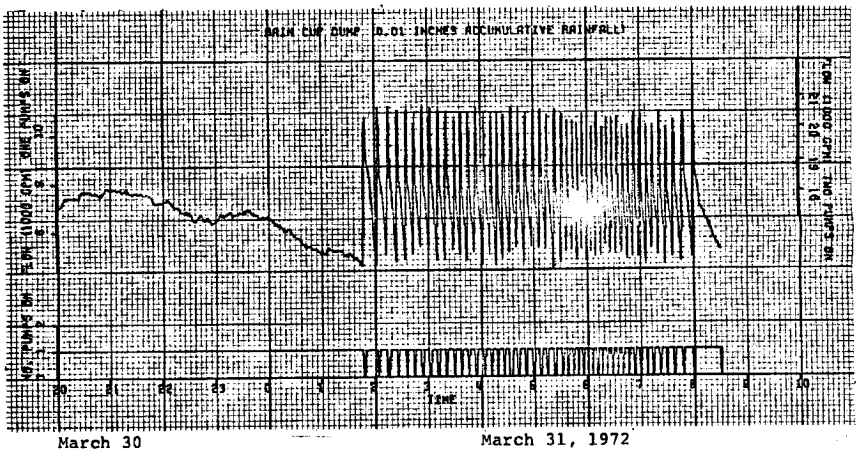
Year	Date	Pumps		Motors	
		No. 1	No. 2	No. 1	No. 2
1964	Jan. 6	In service	In service	In service	In service
1965	Mar. 25	Repacked	--	--	--
1966	--	--	--	--	--
1967	May 24	--	--	New bearings @ 10,297 hours	--
	Sept. 8	--	--	--	New bearings
1968	May 10	Overhauled,3 bearings seal,sleeve,packing	--	--	--
	May 17	--	Overhauled,3 bearings seal,sleeve,packing	--	--
1969	Oct. 31	--	--	New contacts and overloads	--
1970	Mar. 18	--	--	--	Install solenoid,seal gland, roto meter, strainer and regulator
	May 27	--	--	Modified to lead-follow	--
	June 9	Overhauled,3 bearings seal,sleeve,packing	--	--	--
	June 12	Cleaned check valves	--	--	--
1971	Dec. 30	--	--	--	Light and transformer



February 29 March 1, 1972



March 5 March 6, 1972



March 30 March 31, 1972

DESIGN EL	DRAWN RL	DIVISION	MUNICIPALITY OF METROPOLITAN SEATTLE	DATE: April 72
RECOMMENDED		West Point	East Marginal Way Pumping Station Modifications	FILE NO. 7207
APPROVED			TYPICAL PERFORMANCE OF PUMPING STATION	Fig. 2

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C. PROPOSED IMPROVEMENTS

1. Alternate Expansion Plans

The performance of the existing pumping station demonstrates the need for its expansion at this time and also confirms the original design concept of the need to use variable speed pumping units where wet well capacities are held to a minimum. The existing pumping station is constructed with space for three pumping units each discharging into separate 24-inch force mains. The capacity of each force main is 21 mgd and the size of each of the three pumping units is therefore limited accordingly.

The excellent maintenance and reliability record of the existing two pumping units has prompted the investigation of alternate expansion schemes to retain these units without modification or with only minimum changes. Under these conditions however, the pumping station could only be enlarged to fifty percent of its ultimate size due to the limiting capacity of the discharge force mains and would have to be enlarged again at a later date.

The three alternate expansion plans considered are listed in Table 5. All three plans propose the installation of the third pumping unit with the intended design capacity of 21 mgd. The operating data have demonstrated the unsuitability of constant speed pumps with the existing flows and limited wet well capacity and a variable speed drive is proposed for Pump No. 3 in all of the alternates.

Alternates A and B propose the incremental expansion of the station with little or no change to Pumps 1 and 2 as described earlier.

Alternate C corresponds with the original design concept to expand the station to its ultimate capacity as described on Page 97 of the Municipality's Pre-Design Report of August 1970 for its Second Stage Construction Program and is the recommended alternate of this report.

TABLE 5: ALTERNATE EXPANSION PLANS

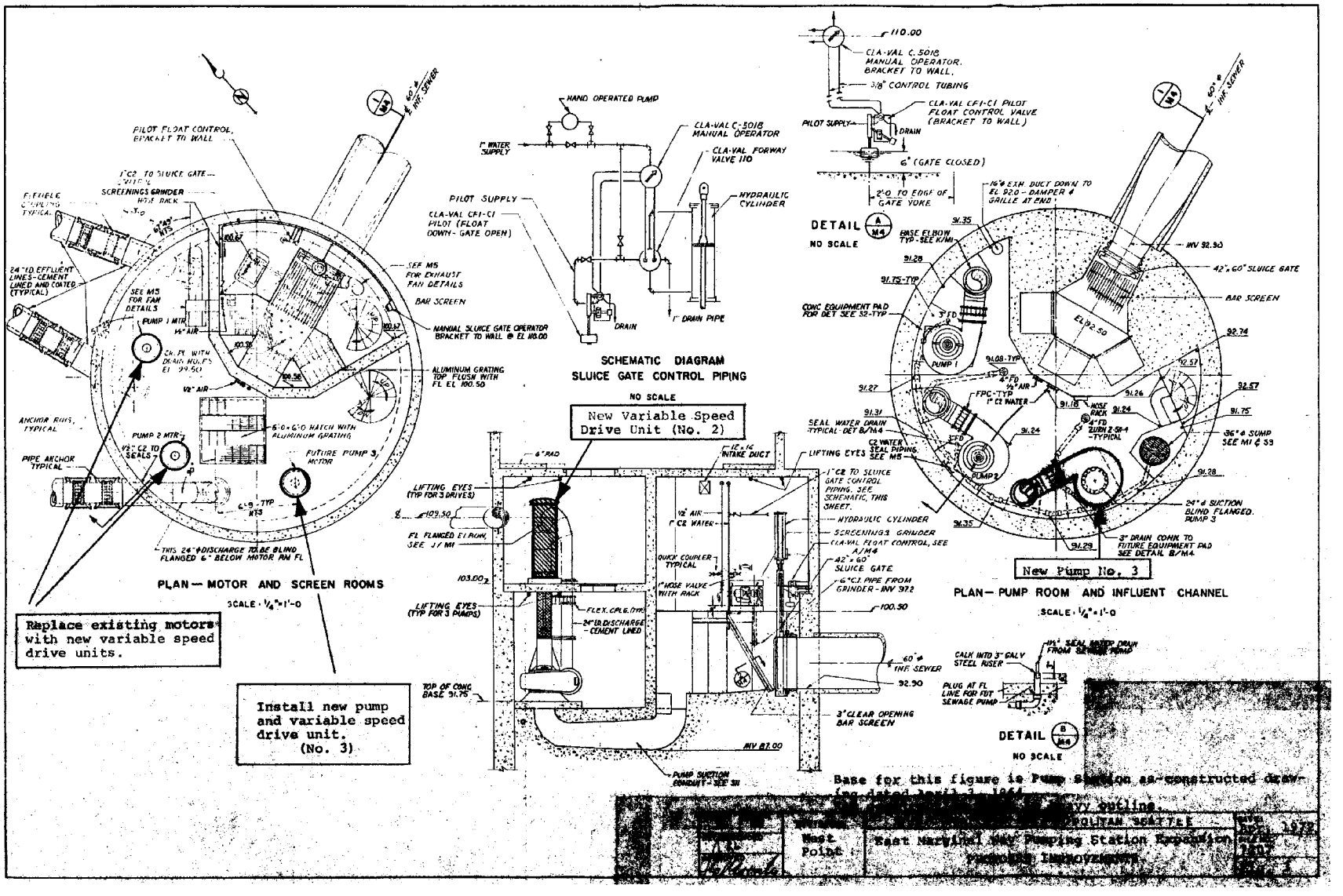
	Station Capacity mgd	Pump No. 1	Pump No. 2	Pump No. 3
Existing Condition	10	10	10	--
Expansion Plans Alternate A (incremental)	21	No change	No change	Add pump 21 mgd variable speed
Alternate B (incremental)	21+	Change impeller 24-3/4 to 26"	Change impeller 24-3/4 to 26"	Same as Scheme A
Recommended - Alternate C (ultimate)	42	Convert to 21 mgd variable speed	Convert to 21 mgd variable speed	Same as Scheme A

2. Preliminary Design of Recommended Expansion Plan

The preliminary design of Alternate C, the recommended expansion plan described in Table 5 is given in the previously referenced pre-design report of August 1970 and the following extract is taken from the report:

> "East Marginal Pumping Station. The East Marginal pumping station is designed for an ultimate capacity of 42 mgd. During the period covered by the first stage program, this station was tributary to the Diagonal Avenue treatment plant which had limited capacity. The capacity of the East Marginal station therefore was limited to 10 mgd. Pumping units installed during the first stage were selected to be able to serve as the ultimate pumping units, but are operated at a speed so that each unit can pump only a maximum of 10 mgd. With the completion of the Elliott Bay interceptor, the station is now tributary to the West Point plant and its capacity should be increased to ultimate requirements.
>
> Construction at the East Marginal station during the second stage will involve replacement of the motors on the two existing pumps with larger variable speed units, installation of a third pumping unit, modification of the control system and miscellaneous improvements. Each of the pumping units will have a capacity of 21 mgd."

A plan of the existing station and the proposed improvements is given on Figure 3.



3. Cost Estimate

The construction cost estimate for the recommended expansion of the East Marginal Way Pumping Station is given in Table 6 which is taken from Page 92 of the 1970 Pre-Design Report.

TABLE 6: CONSTRUCTION COST ESTIMATE

East Marginal Pumping Station

Installation of new motors and additional pumping unit to increase capacity to ultimate requirement of 42 mgd.

Pumping unit	$ 25,000
New motors	30,000
Revision to control system	25,000
Miscellaneous	15,000
Basic construction	95,000
Contingencies	10,000
Subtotal, 1970 Report Estimate	105,000
TOTAL, 1973 Cost @ 1.15	$120,750
Use	$121,000

4. Project Schedule

It is estimated that the work described to construct the expansion plan recommended will have the following time requirements:

a. Preliminary Phase

Through submittal of executed grant application and completion of exhibits and required proceedings	April - July 1972 100 days

b. Design Phase

Through completion and approval of contract documents, receiving of all permits and grant offer and execution of grant acceptance	August - December 197 125 days

c. Construction Phase

Through project completion and acceptance	Summer 1973 120 days

An itemized schedule for the work is given in Table 7.

TABLE 7: PROJECT SCHEDULE

Item	Description	Elapsed Time, days	Scheduled Date
A.	**Preliminary Phase (1972)**		
1.	Begin engineering report	0	Mar. 27 (M)
2.	Complete engineering report	32	Apr. 28 (F)
3.	Submit pre-application notice for grant	32	Apr. 28 (F)
4.	Receive grant applications	49	May 15 (M)
5.	Begin application, exhibits & proceedings	49	May 15 (M)
6.	Complete proceedings and exhibits, execute applications	99	July 6 (Th)
7.	Submit grant application	100	July 7 (F)
B.	**Design Phase (1972)**		
8.	Begin contract documents	130	Aug. 4 (F)
9.	Complete contract documents and submit for approvals	159	Sept. 22 (F)
10.	Receive approvals	235	Nov. 17 (F)
11.	Receive permits	242	Nov. 24 (F)
12.	Receive grant offer	249	Dec. 1 (F)
13.	Execute and submit grant acceptance	255	Dec. 7 (Th)
C.	**Construction Phase (1973)**		
14.	Advertise for bids	0	
15.	Receive bids	20	Flexible,
16.	Award contract	30	summer
17.	Execute contract	45	construction
18.	Notice to proceed	50	desirable
19.	Project completion and acceptance	120	

D. RECOMMENDATIONS

Based on the foregoing report, the following recommendations are made:

1. The recommended plan for expansion of the East Marginal Way Pumping Station to its ultimate capacity should be implemented in accordance with the findings of this report and the schedule shown in Table 7.

2. An application for grant assistance should be started immediately, together with preparation of all exhibits and supporting documents required.

3. Applications for permits and approvals from affected agencies having jurisdiction should be filed as soon as possible.

4. Further analysis and refinement of the computer monitored operations of the station should be continued to provide as much data as possible for final design of the improvements.